FUZZY SYSTEM PROJECT REPORT

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Recursive Least Squares Algorithm

Fuzzy Systems Course

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Designing Fuzzy System using Recursive Least Squares Algorithm Report

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In this technique, like the Gradient Descent technique, we must first specify the structure of the fuzzy system, then update the centers of the output membership function (y^l). The details of our fuzzy system are as follows: PIE, Singleton fuzzifier , Center of Average defuzzifier and Optional membership function.

Rule Base

Just like Table look up technique, we have to create a rule base here and it must be a complete rule base. We create our rule base with this code:

```
PR = prod(MFN);
Repeat = 1;
Rules = zeros(PR,InputNum);
for i=1:InputNum
    PR = PR/MFN(i);
    for l=1:Repeat
        for k=1:MFN(i)
            for j=1:PR
                Rules(j+(k-1)*PR+(l-1)*PR*
MFN(i),i) = k;
            end
        end
    end
    Repeat = Repeat*MFN(i);
```

```
    end
```

We should initialize parameter θ so we use same initialing method as on-line initial parameter choosing. Then we must update our parameters as below:

```
for p=1:size(Pairs,1)

    b_x = CalculatingB(Pairs(p,1:end-
1),Rules,MFN,MFType,UpBnd,LowBnd);
    K_p = P*b_x*(1/(b_x'*P*b_x+1));
    Theta = Theta+K_p*(Pairs(p,end)-b_x'*Theta);
    P = P-P*b_x*(1/(b_x'*P*b_x+1))*b_x'*P;

end
```

As you see we use a function to calculate b parameter. Here is the function:

```
MuoValue = zeros(size(Rules));

    for i=1:size(Rules,1)
        for j=1:size(Rules,2)
            MuoValue(i,j) =
CalculatingMuo(Data(j),Rules(i,j),MFNum(j),MFTyp
e(j),UpBnd(j),LowBnd(j));
        end
    end

    a = prod(MuoValue,2);
    b = sum(a);
    FinalB = a/b;
end
```

Result

Result for this parameters.

Sigma: 100

Number of Data Pairs: 250

Number of Samples: 500

Number of Membership Functions: 6

Type of Membership Function: Gaussian

Number of Inputs: 4

Lower Bound: 0.2

Upper Bound: 1.4

Mean Absolute Error: 0.0090

Mean Square Error: 5.9012e-04